PROPOSED UPGRADE OF TRANSNET HELIPAD AND ASSOCIATED INFRASTRUCTURE AT THE PORT OF RICHARDS BAY WITHIN UMHLATHUZE LOCAL MUNICIPALITY IN THE KWAZULU NATAL PROVINCE.

Prepared for Nsovo Environmental Consulting

By

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(Confluent Environmental (Pty) Ltd)

September 2022

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aquatic consulting & research

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- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);
- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public;
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- All the particulars furnished by me in this document are true and correct.

Specialist: Dr. James Dabrowski (Ph.D., Pr.Sci.Nat. Water Resources)

Date: 14 September 2022

EXECUTIVE SUMMARY

Confluent Environmental (Pty) Ltd was appointed by Nsovo Environmental Consultants to conduct a specialist estuarine impact assessment for the proposed extension of the Transnet Helipad, located in Richards Bay, in northern KwaZulu-Natal. The extension is required as the current helipad does not meet the requirements of the South African Civil Aviation Authority. The upgrade will involve constructing a new helipad that will extend approximately 15 m from the existing shoreline into the subtidal zone of the Richards Bay estuary. The upgrade of the helipad is however also constrained by the location of an existing navigation channel located to the west of the site. This channel is routinely dredged by the Transnet National Ports Authority. Three alternative design options have been proposed and were assessed in this report.

Despite its highly modified state, numerous studies have highlighted the Richards Bay estuary as being of national importance with respect to hosting a diverse range of estuarine habitats and associated fauna and flora. At the same time, the Port of Richards Bay is South Africa's leading port in terms of cargo volumes handled and is also the biggest port in size, covering an area of approximately 3 773 ha. Port infrastructure therefore requires routine maintenance and upgrades. It is therefore important that further developments and upgrades in the estuary do not compromise ecologically sensitive habitats. In this respect, the upgrade to the helipad occurs in an area that has already been transformed (by rock revetments and routine dredging) and no habitats that are regarded as ecologically sensitive (i.e. mud and sandflats, mangroves, REIs etc.) are located within or near to the footprint of the helipad.

Of the three proposed options, Option 1 is preferred and recommended from the perspective of minimising impacts on the estuary. The most significant impact resulting from Option 1 will be the transformation of a small area of intertidal and subtidal soft sand habitat (approximately 390 m^2) into artificial rock habitat. In the context of the greater Richards Bay estuary (which is approximately 1 600 hectares in extent), the area of habitat that will be transformed is however insignificant and no adverse impacts to species of conservation concern or ecological processes are anticipated. Furthermore, intertidal beaches and open water habitat are considered to be the least ecologically sensitive of all available habitats in the estuary. Options 2 and 3 both result in the complete infilling of subtidal and intertidal habitat and a higher likelihood of hydrodynamic impacts associated with deflection of waves of tides from vertical sheet pile walls.

Given its location within a section of the harbour that already hosts existing port services (and the disturbances associated with these services) and considering that all other impacts are low, it is recommended that Option 1 be considered for environmental authorisation.

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1.1 Background

Confluent Environmental (Pty) Ltd was appointed by Nsovo Environmental Consultants to conduct a specialist estuarine impact assessment (as required by the Department of Forestry, Fisheries and the Environment: Oceans and Coast) for the proposed extension of the Transnet Helipad, located in Richards Bay, in northern KwaZulu-Natal. The extension is required as the current helipad does not meet the requirements of the South African Civil Aviation Authority. The upgrade will involve constructing a new helipad that will extend approximately 15 m from the existing shoreline into the subtidal zone of the Richards Bay estuary. The upgrade of the helipad is however also constrained by the location of an existing navigation channel located to the west of the site (Figure 1). This channel is routinely dredged by the Transnet National Ports Authority. Three alternative design options have been proposed for the construction of the new helipad.

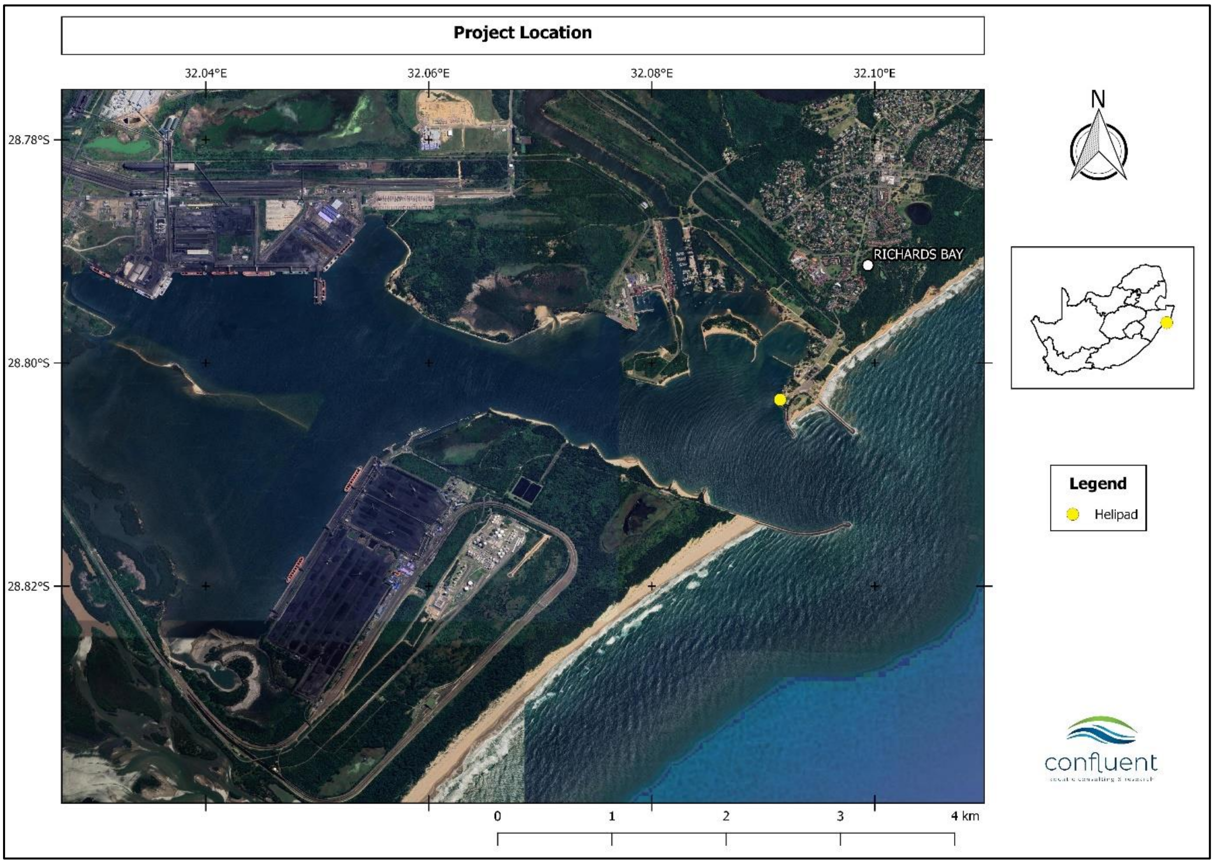

Figure 1: Location of the helipad

1.2 Overview of Design Options

The BAR specifies a preferred alternative from an a) layout (four alternatives); and b) technical perspective (three alternatives). Only the technical alternatives have been assessed in his report as all four layout alternatives will have a similar impact on the estuary.

1.2.1 Option 1: Deck on Pile

This will involve the construction of a 31 m x 26 m reinforced concrete deck supported by beams resting on bored piles (Figure 2). The outer edge of the helipad will be located approximately 7.3 m from an existing marine navigational channel. Rock revetment will be placed beneath the deck to prevent soil erosion due to wave action. The summarised construction methodology is as follows:

- Prepare the slope for the revetment below the deck on pile;
- Auger all the piles to the required depths;
- Prepare the slope of the toe of the revetment;
- Lay the geotextile, underlayer and armour layer of the revetment;
- Place precast capping beams connecting the augered piles; and
- Cast in situ deck slabs supported by the capping beams.

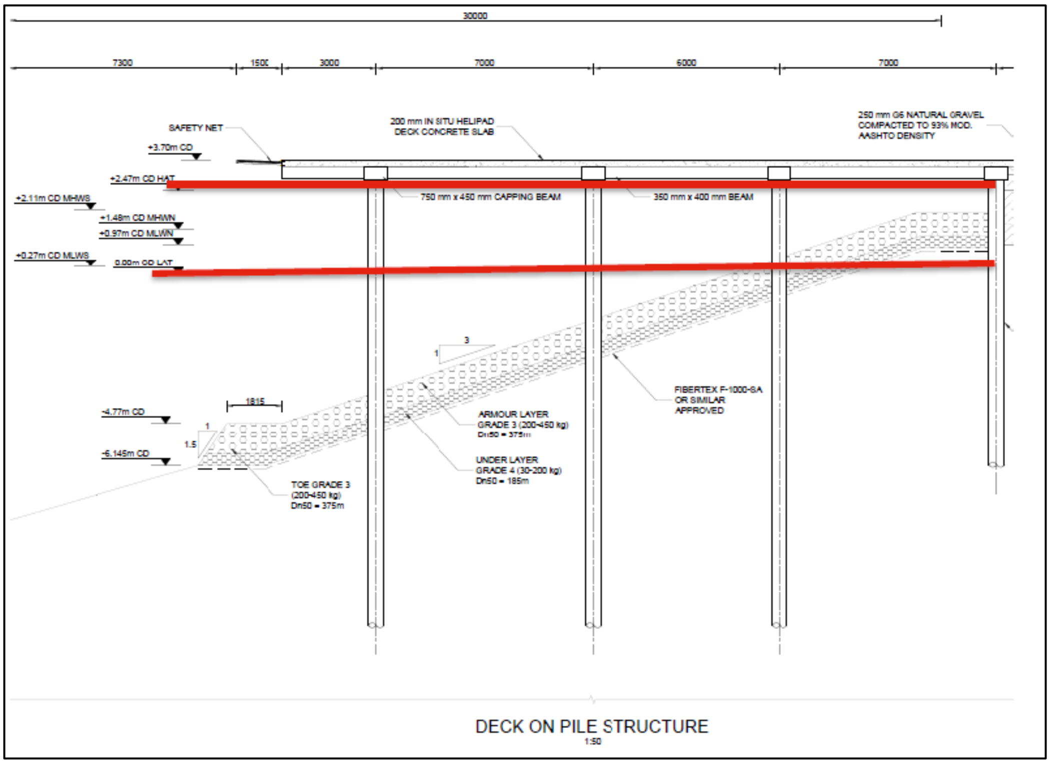

Figure 2: Side elevation drawing for Option 1.

1.2.2 Option 2: Sheet Pile Wall with Rubble Mound

Option 2 will involve the construction of a sheet pile wall (AZ sheets), behind which a sloped rubble mound structure supporting the helipad deck will be located (Figure 3). An anchor block will provide lateral support for the sheet pile wall. The outer edge of the deck will be located approximately 2.3 m from the navigational channel. The summarised construction methodology is as follows:

- Backfill soil layers from the landside towards the seaside in a sequenced manner whilst supporting backfill material with a temporary sheet pile wall;
- Drive permanent AZ sheet pile wall at the required edge position to a depth of approximately;
- Install new anchors with anchor beam;

- Prepare slope for rubble mound structure;
- Place the geotextile, underlayer and armour layer of the rubble mound; and
- Trim the permanent sheet pile wall to a level of 0.50 m Chart Datum (CD),

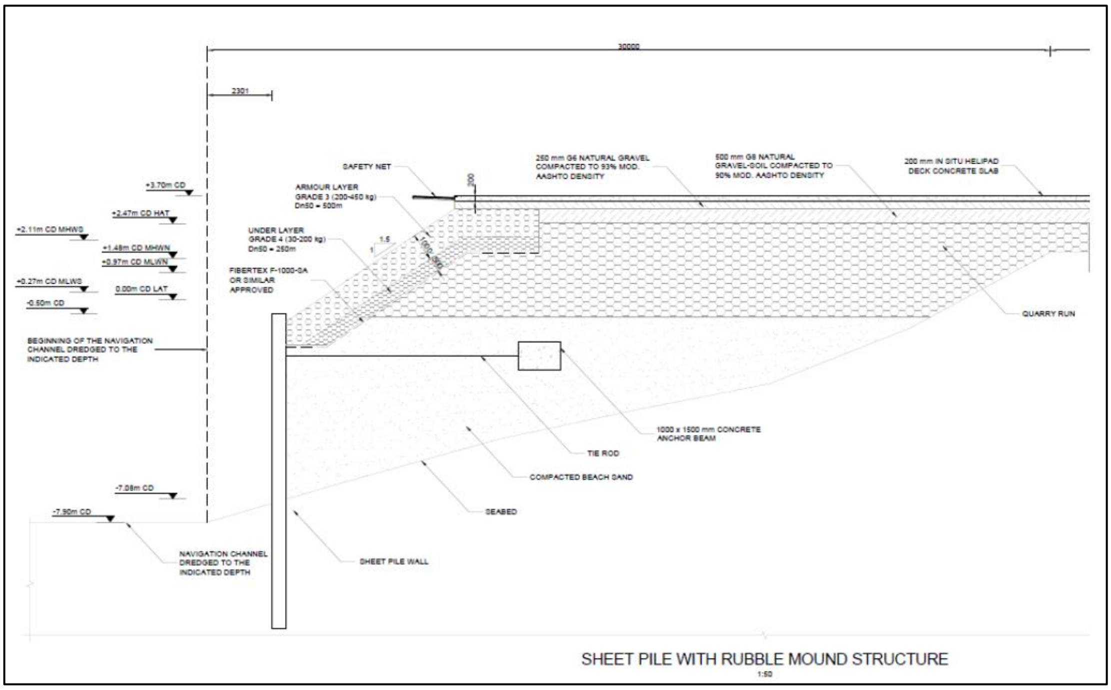

Figure 3: Side elevation drawing for Option 2.

1.2.3 Option 3: Sheet Pile Wall

Option 3 involves the construction of a higher sheet pile wall (AZ sheets) supported laterally by an anchor block (Figure 4). The outer edge of the deck will be located approximately 7.3 m from the navigational channel. The summarised construction methodology is as follows:

- Backfill soil layers from the landside towards the seaside in a sequenced manner whilst supporting backfill material with a temporary sheet pile wall;
- Drive permanent AZ sheet pile wall at the required edge position to a depth of 20 m CD and cope level of approximately 3.70 m CD;
- Install new anchors with anchor beam;
- Backfill soil material above the anchors to the soffit of the deck slabs; and
- Cast in situ deck slabs supported by backfill material.

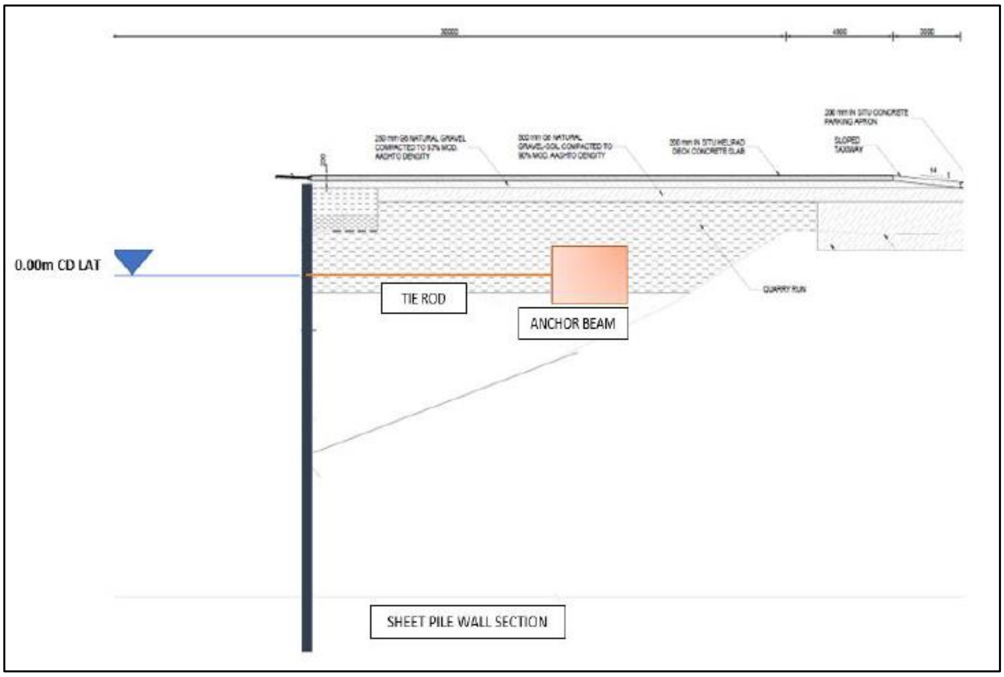

Figure 4: Side elevation drawing for Option 3.

1.3 Key Legislative Requirements

1.3.1 National Environmental Management Act (NEMA, 1998)

According to the protocols specified in GN 320 of 20 March 2020 (Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act (NEMA), 1998, when Applying for Environmental Authorisation), assessment and reporting requirements for aquatic biodiversity are associated with a level of environmental sensitivity identified by the national web-based environmental screening tool (screening tool). An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being of:

- **Very High** sensitivity for aquatic biodiversity, must submit an Aquatic Biodiversity Specialist Assessment; or
- **Low** sensitivity for aquatic biodiversity, must submit an Aquatic Biodiversity Compliance Statement.

According to the protocol, prior to commencing with a specialist assessment a site sensitivity verification must be undertaken to confirm the sensitivity of the site as indicated by the screening tool:

- Where the information gathered from the site sensitivity verification differs from the screening tool designation of **Very High** aquatic biodiversity sensitivity, and it is found to be of a **Low** sensitivity, an Aquatic Biodiversity Compliance Statement must be submitted.
- Similarly, where the information gathered from the site sensitivity verification differs from the screening tool designation of **Low** aquatic biodiversity sensitivity, and it is found to be of a **Very High** sensitivity, an Aquatic Biodiversity Specialist Assessment must be submitted.

The screening tool identified the site as being of **Very High** aquatic biodiversity owing to the fact that the proposed construction of the helipad will extend into an undeveloped area of the estuary. A detailed site verification visit was therefore undertaken to confirm the site sensitivity and to report accordingly.

All NEMA listed activities falling under the scope of this study have been identified in the Basic Assessment Report (BAR) and no approvals under the NEMA:ICMA are required.

1.4 Scope of Work

The scope of work is to compile a specialist estuarine report as input to a Basic Assessment Report (BAR) for the proposed development which complies with the relevant legislation pertaining to NEMA (Act No. 107 of 1998) and the Integrated Coastal Management Act (Act No. 24 of 2008). This included, *inter alia*, the following:

- Desktop literature review of estuary including relevant national and provincial conservation and management plans;
- A site visit to assess the current ecological state of the affected portion of the estuary and; and
- An assessment of the construction and operational phase impacts (for three different design options) on the biodiversity of the estuary.

The site visit was conducted on the 6th of September 2022.

2. ASSUMPTIONS AND LIMITATIONS

- The dynamic nature of estuaries means that the structure of physical habitat and associated estuarine fauna and flora can change rapidly in response to tidal and hydrological influences. This assessment is based on a single site visit that took place on 6th of September 2022 and represents a 'snapshot' in time;
- Many studies have been conducted on the estuary over the past few decades. Many of these studies provide valuable information on the ecology of the estuary and provide a relatively comprehensive overview of the fauna and flora of the estuary – more so than would be achieved from limited sampling that would otherwise be conducted to meet the objectives of this assessment. It has been assumed that available historical literature and data remains relevant to the assessment; and
- Apart from visual observations that were made during the site visit no sampling of biota was undertaken and all biotic data was derived from desktop sources.

3. STUDY AREA

3.1 Richards Bay Estuary

In South Africa, the Estuarine Functional Zone (EFZ) is defined as the area that not only delineates the boundaries of the waterbody, but also the supporting physical and biological processes and adjacent habitats necessary for estuarine function and health (Van Niekerk et al., 2019a). It includes all dynamic areas influenced by long-term estuarine sedimentary processes, multiple ecotones of floodplain and estuarine vegetation that contribute organic material and provide refuge from strong currents during high flow events. EFZs are currently delineated by the 5 m contour line and therefore include large areas of land (much of which have been developed) that border the actual water body.

The Richards Bay estuary is located to the north of Durban in KwaZulu Natal province. It is located within quaternary catchments W12F (which is drained by the Mhlatuze River), and W12J (which is drained by the Mzingazi River). The current delineated extent of the Richards Bay EFZ used to historically be part of what was known as the larger uMhlathuze estuarine lake system. Five main rivers used to drain into this system and included the Mtantatweni (which drains Lake Cubhu), the Mhlatuze (the major river that drained through a delta area of swamp vegetation into the western part of the basin), the Bhizolo and Manzinyama rivers and the Mzingazi (draining Lake Mzingazi). The development of the Richards Bay port in the early 19070s resulted in major modifications to the estuarine lake system, the most significant being that it was artificially split by a berm into northern and southern sections, what are now known as the Richards Bay and uMhlathuze estuaries, respectively (Figure 5). The Mhlatuze River was redirected into the southern uMhlathuze estuary and as this was the main river supplying the former estuarine lake system, freshwater inputs into northern Richards Bay estuary were considerably reduced, and the main freshwater inputs are currently received from the Bhizolo and Manzinyama rivers, which currently serve as drainage canals (DEA, 2018).

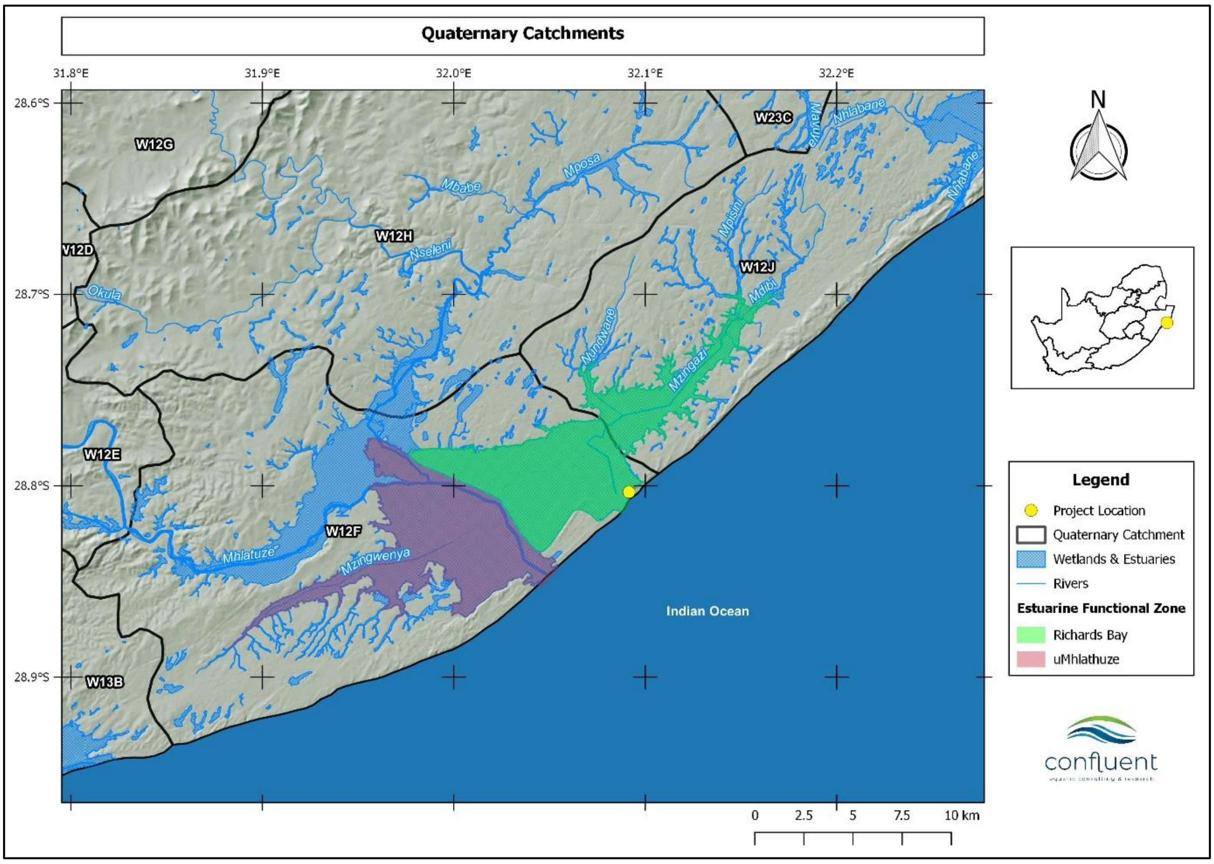

Figure 5: Map indicating the estuarine functional zones (EFZs) of the Richards Bay and uMhlathuze estuaries.

Activities associated with the development of the port, including dredging, wharf construction, infilling, widening of the mouth and stabilisation and breakwater construction have resulted in considerable modifications to the Richards Bay estuary. The widening and deepening of the pre-existing mouth to act as a port entrance channel resulted in a significant increase in tidal range resulting in the loss of large areas of shallow subtidal and intertidal habitat (Weerts and Mackay, 2019).

Despite these modifications, the Richards Bay and uMhlathuze estuaries are still considered to be unique and highly productive ecosystems that support complex food webs and function as an important breeding area for a diverse range of marine and estuarine organisms. Between these two systems they offer almost the complete range of habitat types found in tidal reaches of estuaries, including intertidal and subtidal mud- and sandflats, sandbanks, mangroves and seagrass beds. The Richards Bay estuary is ranked as the 26th most important estuary in South Africa, and, together with the uMhlathuze estuary, hosts the largest area of mangroves out of all South African estuaries (DEA, 2018).

3.2 Estuary Classification

As highlighted above, the Richards Bay estuary was formerly part of a larger Estuarine Lake which are typically large circular water bodies connected to the sea by a constricted inlet channel (Van Niekerk et al., 2019b). Following the extensive modifications that have occurred, the Richards Bay estuary now functions and is classified as an Estuarine Bay. Defining characteristics of Estuarine Bays include the following (Van Niekerk et al., 2019b):

- Estuarine Bays are permanently linked to the sea by unrestricted, deep mouths and are dominated by tidal processes, with tidal amplitudes close to those of the sea.
- Estuarine Bays are large systems (> 1200 ha) with generally round basins where only the upper reaches experience a degree of constriction to tidal flows.
- As a result of relatively low river inputs they have a predominantly euhaline salinity regime (i.e. sea water) in the lower and mid reaches, with freshwater mixing processes being mostly confined to the restricted upper areas.
- Sediments are typically marine in origin and grain size distributions are stable.

3.3 Conservation Planning

3.3.1 National Freshwater Ecosystem Priority Areas

The Richards Bay EFZ falls within several sub-quaternary catchments (SQCs) that have not been designated as Freshwater Ecosystem Priority Areas (FEPA) (Figure 6) (Nel et al., 2011). The catchment area is therefore not considered to be a priority for maintaining freshwater biodiversity at a national scale. This is largely as a result of the extensive industrial development that has occurred throughout most of this catchment, which has led to the degradation of watercourses, particularly in their lower reaches where they flow into the estuary. The Richards Bay Estuary has not been classified as an Estuary Freshwater Ecosystem Priority Area.

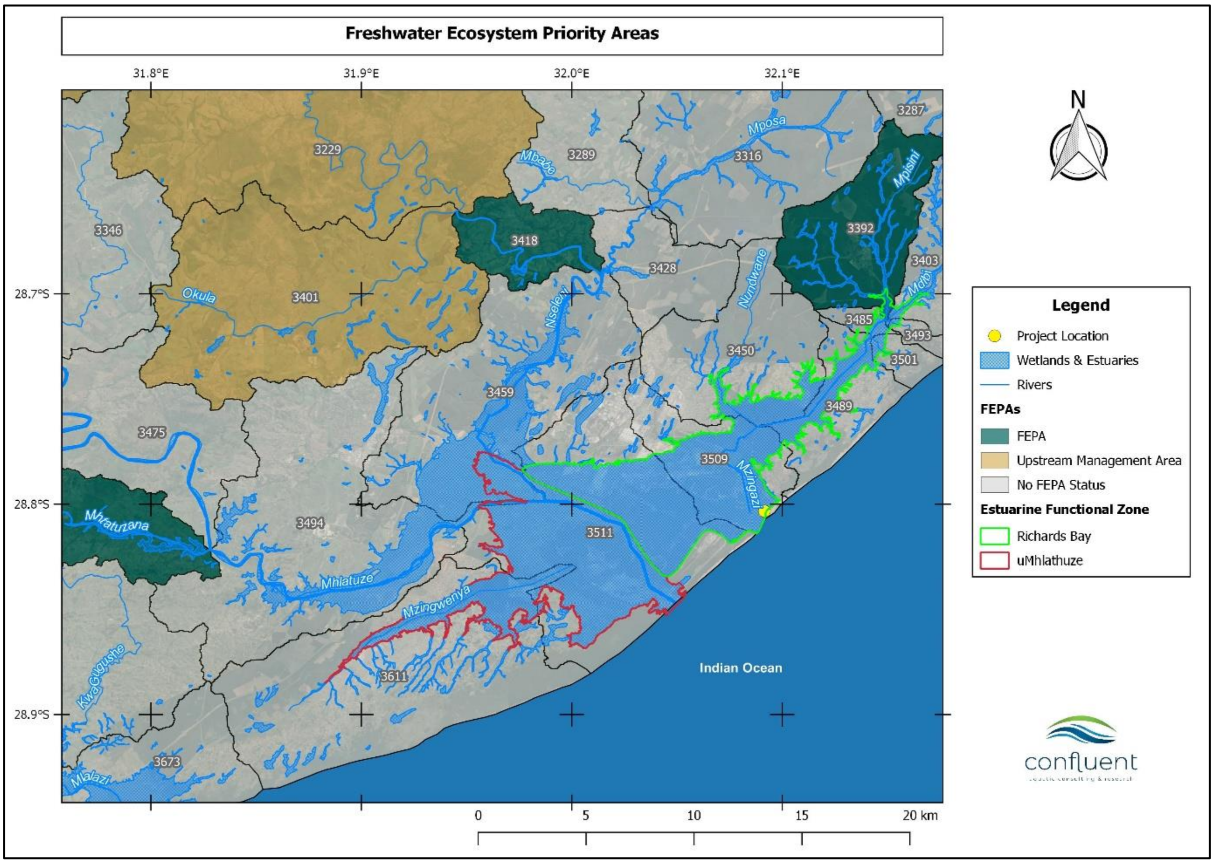

Figure 6: Map illustrating the loaction of the project area in relation to FEPA sub-quaternary catchments.

3.3.2 Kwa-Zulu Natal Spatial Biodiversity Plan

According to the KwaZulu Natal Spatial Biodiversity Plan (Ezemvelo KZN Wildlife, 2016) part of the development area falls within an Irreplaceable Conservation Biodiversity Area (CBA) (Figure 7). Irreplaceable CBAs are areas that are considered critical for meeting biodiversity targets and thresholds, and which are required to ensure the persistence of viable populations of species and the functionality of ecosystems. The management objective for such areas is to maintain them in a natural or near-natural state, with limited to no biodiversity loss.

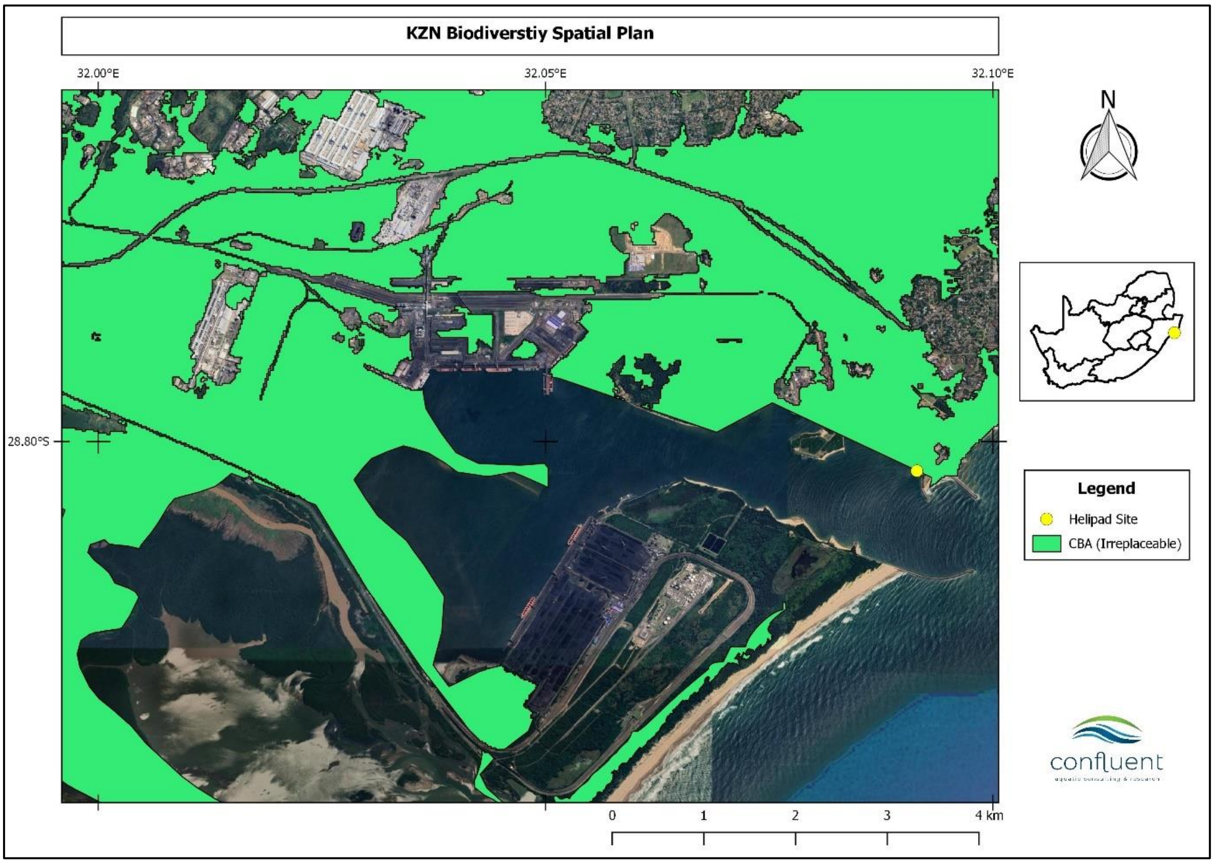

Figure 7: Map indicating the area of development in relation to Critical Biodiversity Area 1 as indicated by the KwaZulu-Natal Spatial Biodiversity Plan.

3.3.3 uMhlathuzi and Richards Bay Estuarine Management Plan

Sections 33 and 34 of the National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) envisage that estuaries are to be managed in a collaborative and cooperative manner through the development and implementation of Estuarine Management Plans (EMPs). The Act in turn envisages that EMPs are to be developed in accordance with a National Estuarine Management Protocol (“the Protocol”) published in terms of the Act. The uMhlathuze and Richards Bay EMP was drafted in 2018 in accordance with the provisions of the Act and the National Estuarine Management Protocol (DEA, 2018).

Management objectives and associated actions have been developed to address a range of impacts and threats with the aim of achieving the vision of the EMP, which is as follows:

“The uniqueness and socio-economic values of our beautiful estuaries are sustainably protected for future generations through responsible, holistic and inclusive management approaches”

With respect to the development assessed in this report, management objectives associated with land-use and infrastructure planning development are relevant and are described in Table 1.

Table 1:Management objectives associated with the construction of infrastructure in the Richards Bay estuary.

Management Objective	Actions
Ensure that planning, construction, maintenance of infrastructure in uMhlathuze/ Richards Bay EFZs e.g. in Port of Richards Bay, Richards Bay IDZ and Waterfront Development, is undertaken in an environmentally sustainable manner to protect biodiversity and socioeconomic values benefiting other users.	Conduct strategic planning for future port development, Richards Bay IDZ and Waterfront development taking into consideration biodiversity requirements and socio-economic values benefiting other users in uMhlathuze/Richards Bay estuaries
	Conduct appropriate EIA studies for infrastructure developments in port (e.g. boat repair and dry dock facilities), IDZ and waterfront for future marine aquaculture development in Richards Bay EFZ as per requirements under the NEMA EIA regulations Notice 3.
	Maintain infrastructure in the study area so as to not detrimentally impact on biodiversity and socio-economic values benefiting other users in uMhlathuze/Richards Bay estuaries.

3.3.4 Resource Quality Objectives

In accordance with the National Water Act (NWA), Resource Quality Objectives (RQOs) need to be set for every estuary in South Africa to ensure the protection of these important aquatic resources. Preliminary objectives (referred to as ecological specifications) have been specified for the uMhlathuze Estuary. Currently there are no ecological specifications set for the Richards Bay Estuary under the NWA. These need to be determined as part of the EMP.

3.4 Ecology of Richards Bay Estuary

The Richards Bay estuary is large (approximately 1 600 ha) and comprises a variety of different sensitive habitat types including inter- and subtidal mud- and sandflats, mangroves, coastal forest and inter- and supratidal sandy beaches (MER, 2013). These habitats provide important feeding, breeding and nursery niches for a high diversity of marine and estuarine organisms. According to the Richards Bay EMP the proposed helipad development site falls within an area that has been designated as *'Important Aquatic Mammal and Croc Habitat'* (Figure 8). The majority of estuarine habitat in this area is subtidal and characterised by relatively deep, euhaline water with a soft, sandy substrate. No mangroves or seagrass beds are present within this area. The shoreline of this area is characterised by supratidal beaches and narrow, sandy intertidal beaches. Much of the shoreline has been lined with rock and dolos revetments. The development area of this project falls very close to the mouth of the estuary which is characterised by deeper water and a sandy bottom that is often dredged so as to ensure safe passage of large ships into and out of the harbour.

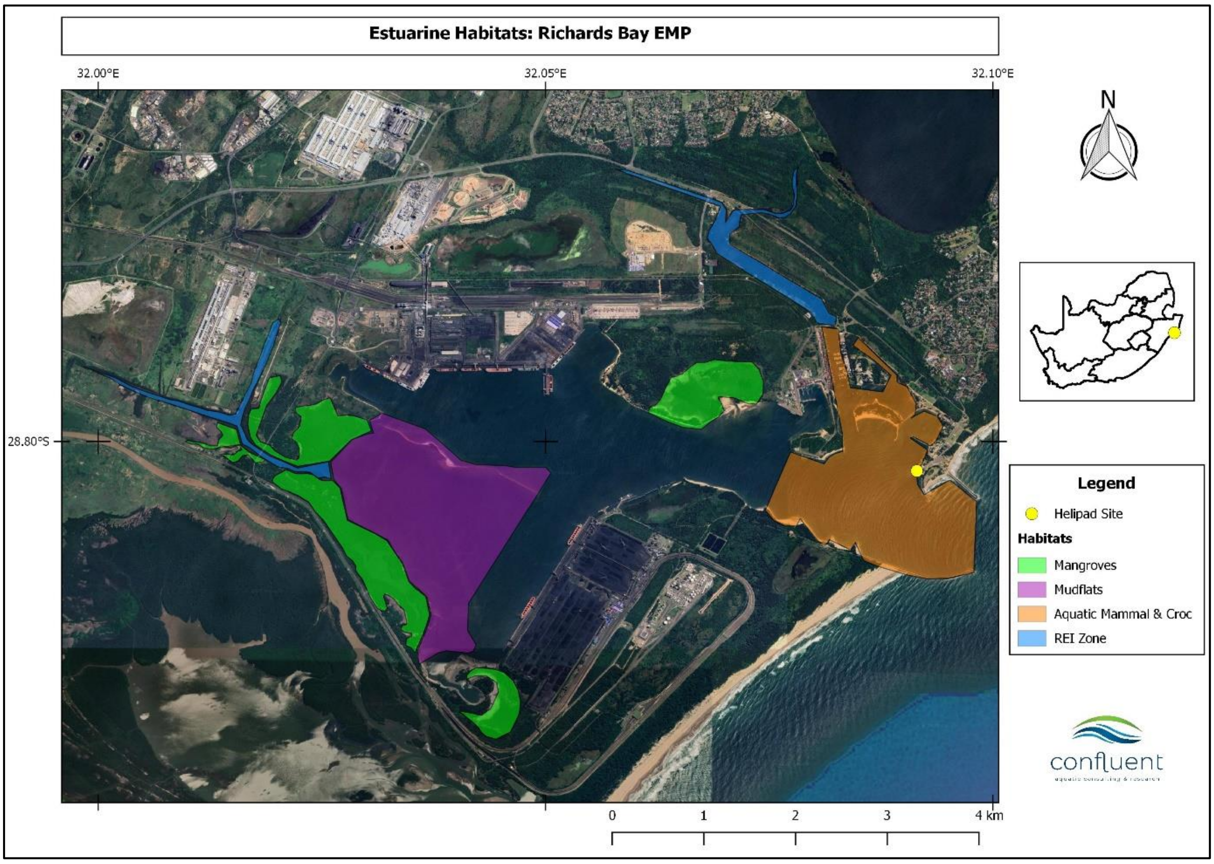

Figure 8: Map indicating the important estuarine habitats delineated in the Richards Bay Estuarine Management Plan (EMP).

3.4.1 Fish

Given its large size and diversity of habitats, the Richards Bay estuary is regarded as an important nursery for estuary dependent marine fishes and in a comparative study of 72 estuaries in the KwaZulu-Natal province, recorded the 5th highest number of species after St Lucia, Kosi Bay, Mlalazi Estuary and Mhlathuze Estuary (Nhleko and Cyrus, 2008 in MER, 2013).

The most detailed study of fish in the Richards Bay estuary was performed by Weerts (2002) which focussed on the relative abundance and diversity of juvenile fish species in a wide range of estuarine habitat types that included sandbanks (at the harbour mouth and in the basin of the estuary), mudflats and three different species of mangrove (see Appendix 1 for the species list). Fish were sampled monthly for a period of year and therefore represents a comprehensive dataset of species that are likely to occur in the estuary. The highest species abundance was generally associated with the mudflats and sandflats (highly productive areas) and comparatively lower numbers in the mangroves. The majority of fish species associated with all of these habitats are estuarine dependent marine fishes. Open water areas (i.e. habitat similar to that which will be developed as part of the helipad upgrade) support comparatively greater densities of fishes that are not dependent on South African estuaries (i.e. predominantly marine species), although they frequently occur in these environments (Weerts 2002). Subsequent shorter-term studies (e.g. Vivier and Cyrus, 2014) have largely supported the findings of Weerts (2002), highlighting mud- and sandflats and mangroves as being important habitats for estuarine dependent marine fish.

3.4.2 Macroinvertebrates

Macroinvertebrate surveys have shown that despite being a highly developed port, the estuary has retained a variety of habitat types that supports diverse macrobenthic communities including a high diversity of Polychaeta as well as Gastropoda, Bivalvia and Crustacea (including a variety of prawn and crab species). The highest species diversity and abundance is associated with the intertidal mud- and sandflat habitats which is indicative of the high productivity of these areas, largely due to the high input of nutrients and organic matter from adjacent mangrove and wetland stands (Izegaegbe et al., 2020). These habitat types have been prioritised as being important for supporting a diverse and unique assemblage of macroinvertebrates that play an important role in maintaining a food chain that supports an ecologically diverse estuarine community (MER, 2013). On the basis of estuary size and from prawn catch records, St Lucia and Richards Bay are by far the major providers of prawn nursery grounds in KwaZulu Natal (MER, 2013). The Bhizolo and Manzamnyama Canals leading into the Richards Bay estuary have both reported very high abundance of prawn species (mainly *Acetes erythraeus*) throughout the year and are likely to play an important role as a prey species for benthic feeding juvenile fishes that utilize the port as a nursery area (Weerts et al., 2003). Consequently, these River-Estuary-Interface (REI) zones have by highlighted as important habitats for prawn breeding in the Richards Bay EMP (DEA, 2018 – see Figure 8).

The substrate of sandflats and deeper subtidal open water sections are characterized by fine sand and low organic content, largely due to the influence of wave action and currents. These areas are not as productive and are generally associated with a less diverse and less abundant, although unique species assemblage (Izegaegbe et al., 2020).

3.4.3 Flora

Together with the uMhlathuze estuary, the Richards Bay estuary hosts the largest area of mangrove forests in South Africa, comprised of *Avicennia marina, Bruguiera gymnorrhiza* and *Rhizophora mucronate* (Naidoo, 2016). Mangroves are unique, highly productive forests that interface between marine and terrestrial environments and typically occur in protected and sheltered coastal and estuarine habitats. As described above, they play an important role in supporting diverse benthic and fish fauna in the Richards Bay estuary. Seagrass (*Zostera capensis*) typically occurs in intertidal flats and lagoons with sand or mud bottoms conditions and are known to support a rich diversity of estuarine fauna. While extensive seagrass beds did historically occur in the greater uMhlathuze estuarine lake, these no longer occur within the Richards Bay estuary (MER, 2013) and are now confined to the uMhlathuze estuary. No distinct estuarine vegetation communities are located within the area designated as *'Important for Sea Mammals and Crocs'*.

3.4.4 Birds

The Richards Bay estuary is considered to be of national importance for water bird populations. Turpie et al. (2002) ranked Richards Bay 3rd nationally in terms of its importance to waterbird populations (after the St Lucia and Berg River systems). Of the 135 waterbird species occurring in South African wetlands, 109 have been regularly recorded at Richards Bay (Allan, 2009). In this respect, the intertidal mud- and sandflats provide a high abundance and diversity of prey items as well as suitable roosting areas during high tide and are therefore regarded as important with regards to supporting the diverse bird assemblage in the estuary

(MER, 2013). Mangroves are utilised by a variety of terrestrial and aquatic bird species but in South Africa, the regionally endangered Mangrove Kingfisher is almost exclusively associated with this habitat type.

3.4.5 Mammals

As highlighted above, the project area falls within habitat that has been designated as *Important Aquatic Mammal and Croc Habitat'*. From a mammal perspective an important species that frequents the Richards Bay area is the Indian Ocean Humpback Dolphin (*Sousa plumbea*) which is listed as globally (Braulik et al., 2016) and regionally (Plön et al., 2016) endangered. The Humpback Dolphin ranges along the southern and eastern South African coast, from False Bay to Kosi Bay, in shallow waters typically less than 25 m in depth. The species has been rigorously studied in the Richards Bay area and it has been shown that the core feeding area of Humpback Dolphins is centred at the harbour entrance (Atkins et al., 2004; Keith et al., 2013) which is in relatively close proximity to the proposed location of the helipad (approximately 900 m from the midpoint of the harbour entrance). Humpback dolphins feed predominantly on reef-associated, estuarine and demersal (bottom-dwelling) fish and in KwaZulu-Natal, display a high affinity to estuaries (Keith et al., 2013). The Richards Bay estuary therefore plays an important role in sustaining a diverse fish community that supports species higher up the food chain.

3.5 National Biodiversity Assessment

The 2018 National Biodiversity Assessment (NBA) evaluated the ecological health of all estuaries in South Africa (Van Niekerk et al., 2019c). This assessment considered both abiotic and biotic components, namely hydrology, hydrodynamics and mouth condition, water chemistry, sediment processes, microalgae, macrophytes, invertebrates, fish and birds. Each estuary was assigned a condition score based on the similarity to natural for these various abiotic and biotic components. For each of the components, a panel of experts estimated the change in health as a percentage (0 – 100 %) of the natural state. Scores were weighted (25 % for each abiotic and 20 % for each biotic component) and aggregated (to provide an overall score that reflects the present health of the system as a percentage of that under natural conditions. While the Richards Bay estuary has been identified as being important for biodiversity, the system has been heavily impacted by the development and operation of the port. Thus, according to the 2018 NBA, the Condition Status of the Richards Bay Estuary is **D (Heavily Modified)**, indicating that a large shift in natural processes and ecosystem function and/or loss of habitat and biota have occurred (Table 2). According to Van Niekerk et al. (2019d) the ecosystem threat status of the Richards Bay Estuary, which was historically a sub-tropical Estuarine Lake, is **Endangered**. These systems are poorly protected in South Africa.

Table 2: Summary of the Present Ecological Status (PES) and Ecological Importance of the Richards Bay estuary.

Category	Index	Score
Abiotic Components	*Hydrology*	*D*
	Hydro-dynamics	*D*
	Physical Habitat	*E*
	Water Quality	*D*
Biotic Components	*Microalgae*	*D*
	Macrophytes	*F*
	Invertebrates	*E*
	Fish	*E*
	Birds	*D*
	Ecological Health	**D**

4. SITE VISIT

The site visit was conducted on the 6th of September, 2022. The estuarine shoreline along which the helipad is proposed to be constructed has been transformed through the placement of rock revetments and dolosse along the shoreline (Figure 9). It was evident that an initial sloped sea wall (constructed from stone and mortar) had failed in certain parts and had been covered by a more recent rock revetment solution. Former supratidal beach/dune habitat has been completely transformed by the existing helipad site and an informal unpaved parking area (to the north of the existing helipad) (Figure 10). There is a very narrow intertidal sandy beach section that is only exposed at low tide. The majority of available habitat is deeper, sandy open water with a soft, sandy substrate. There is no submerged or emergent estuarine vegetation present. A row of invasive *Casuarina cunninghamiana* run in between the existing helipad and the rock revetment. Two T-jetties are located to the north of the helipad site. The Transnet Ports Authority dredger moors near these jetties to pump spoil through pipelines housed on the jetties. This spoil is pumped onto the Alkanstrand Beach (to the east of the helipad site) to replenish sand that is routinely lost due to coastal erosion. A satellite image from the year 2020 shows the dredging ship moored just offshore from the jetties (Figure 11). It is also evident from this image that periodic sedimentation of the water column occurs during this process. The open water habitat adjacent to the proposed helipad is therefore relatively disturbed due to the frequent passage of the dredging ship and due to the actual dredging of the associated navigation channel (which lies approximately 7 m to the west of the outer edge of the helipad (for Option 1 and 3).

Figure 9: Photographs showing a view of the existing helipad and rock revetment from the estuary (A); T- jetties housing pipelines for pumping of spoil from the dredger (B) and (C); rock revetment along the shoreline (D), *Casuarina* trees along the line of the rock revetment (E) and a section of the collapsing sea wall that had been covered by rock armouring (F).

Figure 10: Map showing the approximate location of the proposed helipad relative to the existing helipad and associated buildings (to the east) and the informal parking area to the north. Note the two T-jetties located to the north where the dredger anchors and pumps spoil via pipelines onto the Alkanstrand.

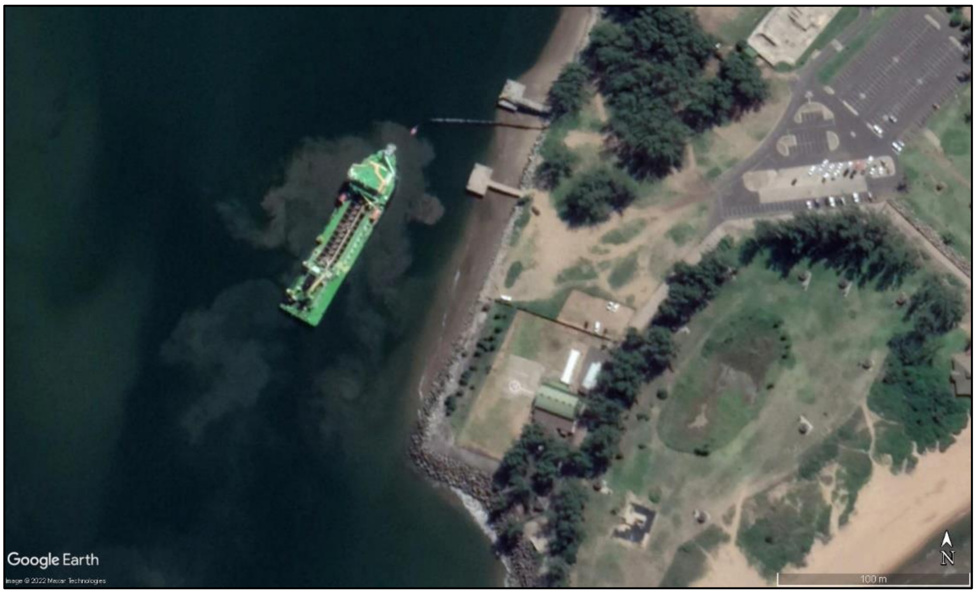

Figure 11: Satellite image showing the dredging ship moored adjacent to the proposed helipad site.

The rock revetment provided artificial habitat for a variety of biota, particularly the Natal Rock Crab (*Grapsus tenuicrustatus*), which were very abundant (Figure 12). Other fauna that were observed included the Green Rock Crab (*Grapsus fourmanoiri*) and molluscs typical of rocky inter-tidal zones, including Natal Rock Oyster (*Saccostrea cuccullata*) and other periwinkle, limpet and barnacle species. Burrows of mud prawn (*Callianassa kraussi*) were observed along the inter-tidal beach although these were not abundant. Numerous shoals of fish were observed utilising the rock revetment, presumably mainly for feeding, but also possibly for evasion of predators.

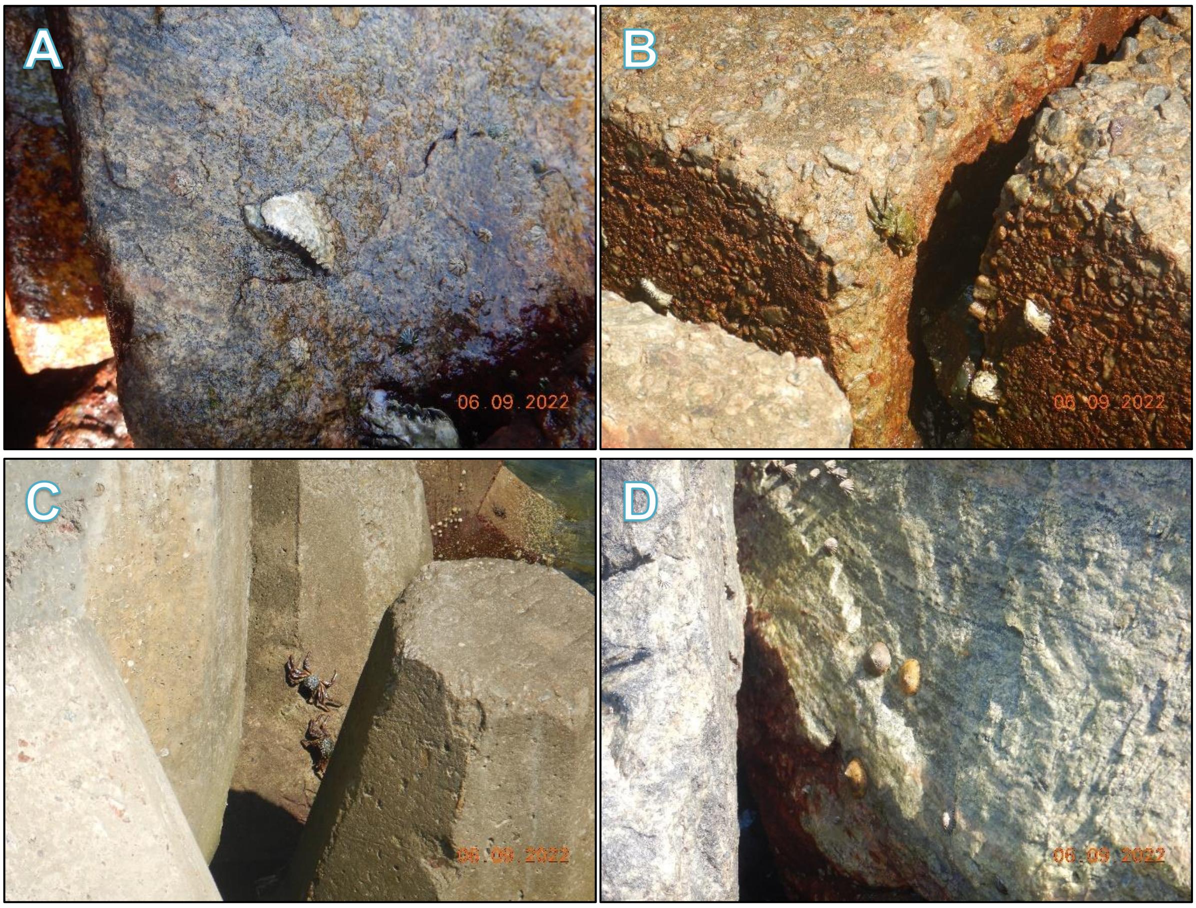

Figure 12: Photographs of biota observed on artifical rock habitat, including *Saccostrea cuccullata* (Natal rock oyster) (A), *Grapsus fourmanoiri* (Green rock crab) (B), *Grapsus tenuicrustatus* (Natal rock crab) (C) and limpet species (D)

Of the fish species recorded by Weerts (2002), three species are currently red-listed by the IUCN as species of conservation concern (Table 3). *Taenoides jacksonii* (Bearded Eelgoby) is listed as Near-Threatened (Skelton, 1996), but was only recorded from mudflat habitats and is unlikely to occur or be dependent on deeper subtidal habitat affected by construction of the helipad. *Rhabdosargus globiceps* is a marine species listed as Vulnerable (Mann et al., 2014). Juveniles often occur in estuaries and it is quite likely that this species may feed on crustaceans and gastropods that occur in the sandy bottom and along the rock revetments. *Silhouettea sibayi* is listed as Endangered and was also reported to occur in the Richards Bay estuary by Weerts (2002). The species was abundant in the mudflats, although it was also reported to occur in open water sandflats and could therefore potentially occur in subtidal habitat affected by the construction of the helipad, although, given the preference of this species for calm water, it is unlikely that it would occur in an area that is frequently disturbed by dredging and subjected to continuous (although light) wave action. Furthermore, according to the most recent red-list assessment (O' Brian et al., 2017) populations of *S. sibayi* are only known from Lake Sibaya, Kosi Bay (KwaZulu-Natal) and Piti (Mozambique) and the presence of this species in Richards Bay therefore requires further confirmation.

Table 3: List of IUCN Red-Listed species recorded by Weerts (2002).

Species	Common Name	Habitat Preference	IUCN Status
Rhabdosargus globiceps	White Stumpnose	Sand-flats	Vulnerable
Silhouettea sibayi	Sibayi gobi	Mud-flats	Endangered
Taenioides jacksonii		Mud-flats	Near-threatened

Bird diversity was and is expected to be relatively low along the affected section of shoreline. A checklist of bird species recorded as part of the South African Bird Atlas Project 2 (SABAP) for the pentad in which the project site is located is included in Appendix 2. This list has been derived from a high number of submitted records (255). Of the 283 species recorded, only 28 are expected to utilise the habitat directly affected by the development (Table 4). The intertidal beach offers a very limited area for waders (e.g. plovers and sandpipers) during low tides and is not expected to be an important foraging area for these birds. Any former natural roosting and nesting habitat in the supratidal zone have been transformed. Affected open water subtidal habitat will largely be utilised by diving and swimming seabirds such as gulls, terns, cormorants and darters for hunting of fish. Utilisation of the habitat is however not expected to be high (or important) given the frequent helicopter and ship activity currently experienced in the area. The majority of species that are likely to use the affected habitat are listed as Least Concern. Habitat that will be lost is however insignificant relative to the larger size of the estuary and it is highly unlikely the area is heavily utilised for feeding or that the helipad upgrade will pose any risk to bird species of conservation concern.

Table 4: List of bird species expected to utilise habitat that will be affected by the helipad upgrade

Common Name		Scientific Name	Regional Red-List Status
Cormorant	Cape	*Phalacrocorax capensis*	EN
Cormorant	White-breasted	*Phalacrocorax lucidus*	LC
Cormorant	Reed	*Microcarbo africanus*	LC
Curlew	Eurasian	*Numenius arquata*	NT
Darter	African	*Anhinga rufa*	LC
Gannet	Cape	*Morus capensis*	VU
Godwit	Bar-tailed	*Limosa lapponica*	LC
Gull	Kelp	*Larus dominicanus*	LC
Gull	Grey-headed	*Chroicocephalus cirrocephalus*	LC
Gull	Franklin's	*Leucophaeus pipixcan*	LC
Osprey	Western	*Pandion haliaetus*	LC
Plover	Common Ringed	*Charadrius hiaticula*	LC
Plover	White-fronted	*Charadrius marginatus*	LC
Plover	Kittlitz's	*Charadrius pecuarius*	LC
Plover	Three-banded	*Charadrius tricollaris*	LC
Plover	Grey	*Pluvialis squatarola*	LC
Sandpiper	Curlew	*Calidris ferruginea*	LC
Sandpiper	Common	*Actitis hypoleucos*	LC
Sandpiper	Marsh	*Tringa stagnatilis*	LC
Sandpiper	Wood	*Tringa glareola*	LC
Tern	Caspian	*Hydroprogne caspia*	VU

Common Name		Scientific Name	Regional Red-List Status
Tern	Common	*Sterna hirundo*	LC
Tern	Sandwich	*Thalasseus sandvicensis*	LC
Tern	Lesser Crested	*Thalasseus bengalensis*	LC
Tern	Greater Crested	*Thalasseus bergii*	LC
Tern	Little	*Sternula albifrons*	LC
Tern	White-winged	*Chlidonias leucopterus*	LC
Tern	Whiskered	*Chlidonias hybrida*	LC

In summary the estuary shoreline has been highly transformed from its natural condition, and the only natural habitat that will be affected by the construction of the helipad will be a very narrow section of intertidal beach and a wider section of subtidal sandy bottom, open water habitat. A study conducted by the CSIR in 2005 rated the ecological significance of the different habitat types within the Port of Richards Bay and concluded that intertidal beaches and deepwater sediments were the least ecologically significant habitats relative to other habitats in the estuary (Cyrus and Vivier, 2014).

5. IMPACTS ASSOCIATED WITH THE DEVELOPMENT

Impacts have been assessed for each of the three proposed options. The proposed activities will not result in modifications to surface flows into the estuary. The development will therefore in no way impact on the base flows or hydrological regime (i.e. timing and magnitude of surface flows) of the estuary or cause fragmentation or loss of ecological connectivity. Furthermore, the proposed activity is of such a scale that will in no way impact on the frequency of estuary mouth closure.

5.1 Construction Phase Impacts

Impact 1 – Mobilisation of sediments and suspended solids caused by construction of helipad foundations

Option 1 involves preparation of the slope and driving piles and placing rock revetment below the footprint of helipad. Options 2 and 3 involve driving sheet piles into the sediment and backfilling behind the sheet pile. All options will therefore most likely result in the mobilisation of sediment and suspended solids into the water column during driving of piles and sheet piles. Wash-out of suspended solids and sediments from the fill material is also expected (although washout is expected to be less for Options 2 and 3 considering that the fill will be placed behind sheet pile wall which should limit interaction with the water column). A brief reduction in the quality of nearshore water is therefore expected during the construction of the helipad foundations.

Impact	Option 1		Option 2		Option 3	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	High	Low	Moderate	Low	Moderate	Low
Duration	Short term	Immediate	Short term	Immediate	Short term	Immediate
Extent	Local	Local	Local	Local	Local	Local
Probability	High	High	High	High	High	High
Significance	**48 Medium**	**28 Low**	**40 Medium**	**28 Low**	**40 Medium**	**28 Low**
Reversibility	High	High	High	High	High	High

Irreplaceability	Low	Low	Low	Low	Low	Low
Confidence	High	High	High	High	High	High

Mitigation:

- If possible, schedule works when tides, currents and waves will be most favourable for minimising disturbance and spread of sediments and disturbed materials; and
- For Option 1, temporary sheet piles must be installed around the perimeter of the proposed rock revetment to isolate the construction activity from the estuary and create relatively dry working conditions (especially during the preparation of the slope). Once sheet piling is in place the preparation of the slope for the rock revetment can take place. As the rock armouring proceeds along the length of the revetment, the temporary sheet-piling can be extracted.

Impact 2 – Hydroacoustic impacts of pile driving on fish and marine mammals

Driving the piles and sheet piles into the sediment will generate noise that will possibly disturb fish and marine mammals. It has been shown that high intensity sound pressure levels, such as generated by pile driving, can potentially cause injury in fish at high received levels (e.g. rupture of the swim bladder and internal hemorrhaging). It is expected that fish will actively avoid the disturbance (which could lead to a temporary decline in local fish diversity and abundance), however some injuries may occur. Humpback dolphins (*Sousa plumbea*) and many other marine mammals are also known to be disturbed by boat noise and pile driving and actively avoid proximity to these noises. It is therefore possible that noise generated from construction activities could temporarily disturb foraging behaviour of dolphins at the harbour mouth – particularly as they rely on vocalisations for feeding and social interaction.

Impact	**Option 1**		**Option 2**		**Option 3**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Moderate	Low	Moderate	Low	Moderate	Low
Duration	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate
Extent	Local	Local	Local	Local	Local	Local
Probability	High	High	High	High	High	High
Significance	**36 Medium**	**28 Low**	**36 Medium**	**28 Low**	**36 Medium**	**28 Low**
Reversibility	High	High	High	High	High	High
Irreplaceability	Low	Low	Low	Low	Low	Low
Confidence	High	High	High	High	High	High

Mitigation:

- Construction activities must however be carefully planned so as to minimise the duration of pile- and sheet-driving.

Impact 3 – Loss of natural inter- and subtidal habitat caused by the construction of the foundation of the helipad.

All three options will cover a narrow section of inter-tidal beach habitat and a broader section of subtidal, soft bottom habitat. In terms of ecological significance, the habitat type that will be lost is relatively abundant throughout the estuarine bay and is not highly sensitive or of high ecological significance (relative to other habitat types available within the estuary). The main biota that will be affected will be sediment dwelling invertebrates. A small section of subtidal foraging habitat will be lost for birds and fish but populations or communities of this species are not expected to be negatively impacted.

Option 1 essentially involves the transformation of soft bottom sand habitat to an artificial rock habitat provided by the revetment. Subtidal and inter-tidal habitat will be available below the deck and a variety of biota (including fish, macrocrustacea and invertebrates) are therefore still likely to make use of this transformed habitat. Option 2 and 3 will result in total loss of existing subtidal habitat. Inter-tidal habitat, similar to what is currently available will be available under Option 2, but this option will result in a greater area of loss of subtidal soft bottom habitat (due to the greater footprint).

The intensity of impact is Moderate for Option 1 as transformed subtidal habitat will still be available and intertidal habitat will remain unchanged. The intensity of impact for Option 3 is High as this option will result in the loss of subtidal and intertidal habitat. The significance of impacts is lower for Option 1 than for other options. Furthermore, in the context of the large size of the estuary (approximately 1 600 ha) and the presence of similar habitat, the area of habitat that will be lost is considered to be negligible.

Impact	Option 1		Option 2		Option 3	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	Low	Low	Moderate	Moderate	High	High
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Extent	Site	Site	Site	Site	Site	Site
Probability	Definite	Definite	Definite	Definite	Definite	Definite
Significance	**50 Medium**	**50 Medium**	**60 High**	**60 High**	**70 High**	**70 High**
Reversibility	High	High	High	High	High	High
Irreplaceability	Low	Low	Low	Low	Low	Low
Confidence	High	High	High	High	High	High

Mitigation:

- The impact cannot be mitigated, however of the proposed options, Option 1 is considered to be the most favourable as a similar area of transformed habitat will still be available.

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Impact 4 – Loss of artificial rock habitat caused by the construction of the foundation of the helipad

All three options will disturb existing inter- and subtidal artificial habitat created by the existing rock revetment. As highlighted in Section 4 the inter-tidal habitat is utilised by a high abundance of macrocrustacea as well as by invertebrates typical of inter-tidal zones. Numerous schools of fish were observed feeding in amongst the rocks. Option 1 will result in the replacement of this habitat with similar inter- and subtidal habitat that will most likely be re-colonised by similar species over the short-term. Options 2 re-creates similar inter-tidal habitat (but no sub-tidal habitat). Option 3 results in high sheet-pile walls and no artificial rock habitat will be re-created.

Impact	Option 1		Option 2		Option 3	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	Minor	Minor	Minor	Minor	Low	Low
Duration	Short term	Short term	Permanent	Permanent	Permanent	Permanent
Extent	Site	Site	Site	Site	Site	Site
Probability	Low	Low	Definite	Definite	Definite	Definite
Significance	**10 Low**	**10 Low**	**40 Medium**	**40 Medium**	**50 Medium**	**50 Medium**
Reversibility	High	High	High	High	High	High
Irreplaceability	Low	Low	Low	Low	Low	Low
Confidence	High	High	High	High	High	High

Mitigation:

- The impact cannot be mitigated, however of the proposed options, Option 1 is considered to be the most favourable as a similar area of transformed habitat will still be available.

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Impact 5 – Impairment of water quality caused by spills and leaks of hydrocarbons from vehicles and machinery working in close proximity to the estuary

Heavy machinery likely to be associated with the construction of the bank upgrade will need to be refuelled and worked on at regular intervals during the construction process. Leaks of hydrocarbon contaminants from this heavy machinery may arise, seeping into the ground, or as run-off into the estuary. This will pollute and negatively affect the water quality.

Impact	Option 1		Option 2		Option 3	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	Moderate	Low	Moderate	Low	Moderate	Low
Duration	Short term	Immediate	Short term	Immediate	Short term	Immediate
Extent	Local	Local	Local	Local	Local	Local
Probability	High	Low	High	Low	High	Low
Significance	**40 Medium**	**14 Low**	**40 Medium**	**14 Low**	**40 Medium**	**14 Low**
Reversibility	High	High	High	High	High	High
Irreplaceability	Low	Low	Low	Low	Low	Low
Confidence	High	High	High	High	High	High

Mitigation:

- An emergency spill response plan must be provided and approved in case of spills (or accidents that may cause spills) of fuel or oil or other contaminants from equipment/machinery onto land or into the estuary;
- All machinery should be readily serviced and inspected for leaks. Machinery needing repairs should not be used for construction at the site until repaired and fully operational;
- Any work or maintenance on the machinery should be done far away from the watercourse, preferably in a work yard or on a concrete surface;
- Refuelling of the machinery must take place away from the watercourse and on a concrete surface to prevent seepage;

- All machinery should be parked off-site, and away from the edge of the watercourse when not in use; and
- Should fuel be stored on site, this must be done in an area enclosed by bunded walls with proper drainage facilities.

5.2 Operational Phase Impacts

Impact 6 – Impact of the helipad foundation on the hydrodynamics of the estuary.

The sloped, porous rock revetment associated with Option 1 dissipates wave energy in the interstices of the revetment and will not alter existing tidal hydrodynamics. In contrast sheet pile walls (i.e. Option 2 and 3) create a solid, vertical barrier, which will deflect more energy associated with wave action and tides which can have unintended geomorphological impacts, including scouring around infrastructure and alterations in sediment deposition patterns. The latter could, for example, require a higher frequency of dredging along the adjacent navigation channel, thereby increasing the frequency of environmental impacts associated with this activity. Any impacts are likely to be very localised given the small size of the helipad relative to the size of the significantly larger estuarine bay.

Impact	Option 1		Option 2		Option 3	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	Low	Low	Low	Low	Low	Low
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Extent	Local	Local	Local	Local	Local	Local
Probability	Low	Low	Probably	Probably	High	High
Significance	**22 Low**	**22 Low**	**33 Medium**	**33 Medium**	**44 Medium**	**44 Medium**
Reversibility	High	High	High	High	High	High
Irreplaceability	Low	Low	Low	Low	Low	Low
Confidence	High	High	High	High	High	High

Mitigation:

- The impact cannot be mitigated, however of the proposed options, Option 1 is considered to be the most favourable as the impact rating is lower than for other options.

Impact 7 – Impact of refuelling and maintenance of helicopter on water quality

The location of the helipad within the estuary poses a risk to water quality in the event of spills of hydrocarbons (fuel and oil) during refuelling or routine maintenance or due to wash-off of residues from the deck into the estuary.

Impact	Option 1		Option 2		Option 3	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	Moderate	Low	Moderate	Low	Moderate	Low
Duration	Short term	Immediate	Short term	Immediate	Short term	Immediate
Extent	Local	Site	Local	Site	Local	Site
Probability	High	Low	High	Low	High	Low
Significance	**40**	**14**	**40**	**14**	**40**	**14**

	Medium	**Low**	**Medium**	**Low**	**Medium**	**Low**
Reversibility	High	High	High	High	High	High
Irreplaceability	Low	Low	Low	Low	Low	Low
Confidence	High	High	High	High	High	High

Mitigation:

- Drainage from the helipad must include fuel and oil separators to prevent spills or runoff of hydrocarbons into the estuary; and
- An emergency spill response plan must be provided and approved in case of spills (or accidents that may cause spills) of fuel or oil or other contaminants into the estuary.

Impact 8 – Impact of increased noise levels on fish and marine mammals.

As highlighted above fish and marine mammals are sensitive to noise and while sound waves generated from the helicopter are likely to be reflected off the water surface, it is possible that increased helicopter activity in closer proximity to the water surface could disturb fish and marine mammals at a highly localise spatial extent.

Impact	**Option 1**		**Option 2**		**Option 3**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Low	Minor	Low	Minor	Low	Minor
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Extent	Local	Site	Local	Site	Local	Site
Probability	Medium	Medium	Medium	Medium	Medium	Medium
Significance	**33 Medium**	**24 Low**	**33 Medium**	**24 Low**	**33 Medium**	**24 Low**
Reversibility	High	High	High	High	High	High
Irreplaceability	Low	Low	Low	Low	Low	Low
Confidence	High	High	High	High	High	High

Mitigation:

- Review take-off and landing procedures with a view to minimising the proximity of the helicopter to the water surface.

6. CONCLUSION

Despite its highly modified state, numerous studies have highlighted the Richards Bay estuary as being of national importance with respect to hosting a diverse range of estuarine habitats and associated fauna and flora. At the same time, the Port of Richards Bay is South Africa's leading port in terms of cargo volumes handled and is also the biggest port in size, covering an area of approximately 3 773 ha. Port infrastructure therefore requires routine maintenance and upgrades. It is therefore important that further developments and upgrades in the estuary do not compromise ecologically sensitive habitats. In this respect, the upgrade to the helipad occurs in an area that has already been transformed (by rock revetments and routine dredging) and no habitats that are regarded as ecologically sensitive (i.e. mud and sandflats, mangroves, REIs etc.) are located within or near to the footprint of the helipad.

Of the three proposed options, Option 1 is preferred and recommended from the perspective of minimising impacts on the estuary. The most significant impact resulting from Option 1 will be the transformation of a small area of intertidal and subtidal soft sand habitat (approximately 390 m^2) into artificial rock habitat. In the context of the greater Richards Bay estuary (which is approximately 1 600 ha in extent), the area of habitat that will be transformed is however insignificant and no adverse impacts to species of conservation concern or ecological processes are anticipated. Furthermore, intertidal beaches and open water habitat are considered to be the least ecologically sensitive of all available habitats in the estuary. Options 2 and 3 both result in the complete infilling of subtidal and intertidal habitat and a higher likelihood of hydrodynamic impacts associated with deflection of waves of tides from vertical sheet pile walls.

Given its location within a section of the harbour that already hosts existing port services (and the disturbances associated with these services) and considering that all other impacts are low, it is recommended that Option 1 be considered for environmental authorisation.

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APPENDIX 1: FISH LIST

Table 5: List of fish species compiled by Weerts (2002) (e = estuarine; edm = estuarine-dependent-marine; m = marine)

Family	Species	Estuarine Association
Elopidae	*Elops machnata*	edm
Megalopidae	*Megalops cyprinoides*	edm
	Hilsa kelee	m
	Dussumierinnae: Tribe Spratelloidini sp. 1	m
	Dussumierinnae: Tribe Spratelloidini sp. 2	m
Engraulidae	*Stolephorus spp.*	m
	Thryssa spp.	edm
Chanidae	*Chanos chanos*	m
Atherinidae	*Atherinomorus lacunosus*	e
Hemiramphidae	*Hypomamphus capensis*	e
	Hippichthys spicifer	e
Platycephalidae	*Platycephalus indicus*	m
Ambassidae	*Ambassis spp.*	edm
	Terapon jarbua	edm
Haemulidae	*Pomadasys commersonnii*	edm
	Pomadasys kaakan	edm
	Pomadasys olivaceum	m
	Lutjanus sp.1	m
	Lutjanus sp. 2	m
Sparidae	*Acanthopagrus berda*	edm
	Crenidens crenidens	m
	Diplodus sargus capensis	m
	Rhabdosargus globiceps	m
	Rhabdosargus holubi	edm
	Rhabdosargus sarba	edm
	Rhabdosargus thorpei	edm
Sparidae	*Sparidae sp. 1*	m
Gerreidae	*Gerres spp.*	edm
Sillaginidae	*Sillago sihama*	m
leiognathidae	*Leiognathus equula*	m
Carangidae	*Caranx spp.*	edm
	Scomberoides sp.	edm
Mugilidae	*Mugilidae spp.*	edm
Blenniidae	*Omobranchus sp. 1*	m
	Blenniidae sp. 2	m
Callionymidae	*Callionymus marleyi*	m

Gobiidae	*Acentrogobius audax*	e
	Bathygobius laddi	e
	Croilia mossambica	e
	Favonigobius reichei	e
	Glossogobius biocellatus	e
	Glossogobius callidus	e
	Mugilogobius inhacae	e
	Oligolepis acutipennis	e
	Oligolepis keiensis	e
	Oxyurichthys spp.	e
	Pandaka silvana	e
	Periophthalmus koelreuteri africanus	e
	Redigobius balteatops	e
	Silhouettea sibayi	e
	Taenioides jacksoni	e
	Gobiidae sp. 1	e
Eleotridae	*Eleotris spp.*	e
Kraemeriidae	*Kraemeria samoensis*	m
Cynoglossidae	*Paraplagusia bilineata*	m
Soleidae	*Solea bleekeri*	edm
Tetraodontidae	*Amblyrhynchotes honckenii*	m
	Arothron immaculatus	m
	Arothron meleagris	m
	Chelonodon laticeps	m
	Torquigener hypselogeneion	m
	Tetraodontidae sp. 1	m

APPENDIX 2: BIRD LIST

Table 6: List of birds expected to occur in the and around the project area.

Common Group Name	Common Name	Species	Regional Red List Status
Apalis	Bar-throated	*Apalis thoracica*	LC
Apalis	Rudd's	*Apalis ruddi*	LC
Apalis	Yellow-breasted	*Apalis flavida*	LC
Barbet	Black-collared	*Lybius torquatus*	LC
Barbet	White-eared	*Stactolaema leucotis*	LC
Barbet	Crested	*Trachyphonus vaillantii*	LC
Batis	Chinspot	*Batis molitor*	LC
Bee-eater	Blue-cheeked	*Merops persicus*	LC
Bee-eater	White-fronted	*Merops bullockoides*	LC
Bee-eater	Little	*Merops pusillus*	LC
Bishop	Southern Red	*Euplectes orix*	LC
Bittern	Little	*Ixobrychus minutus*	LC
Boubou	Southern	*Laniarius ferrugineus*	LC
Brownbul	Terrestrial	*Phyllastrephus terrestris*	LC
Bulbul	Dark-capped	*Pycnonotus tricolor*	LC
Bunting	Cinnamon-breasted	*Emberiza tahapisi*	LC
Bunting	Golden-breasted	*Emberiza flaviventris*	LC
Bushshrike	Olive	*Chlorophoneus olivaceus*	LC
Bushshrike	Orange-breasted	*Chlorophoneus sulfureopectus*	LC
Bushshrike	Gorgeous	*Telophorus viridis*	LC
Bushshrike	Grey-headed	*Malaconotus blanchoti*	LC
Buzzard	Common	*Buteo buteo*	LC
Camaroptera	Green-backed	*Camaroptera brachyura*	LC
Canary	Yellow-fronted	*Crithagra mozambica*	LC
Canary	Brimstone	*Crithagra sulphurata*	LC
Cisticola	Zitting	*Cisticola juncidis*	LC
Cisticola	Rattling	*Cisticola chiniana*	LC
Cisticola	Lazy	*Cisticola aberrans*	LC
Cisticola	Rufous-winged	*Cisticola galactotes*	LC
Coot	Red-knobbed	*Fulica cristata*	LC
Cormorant	Cape	*Phalacrocorax capensis*	EN
Cormorant	White-breasted	*Phalacrocorax lucidus*	LC
Cormorant	Reed	*Microcarbo africanus*	LC
Coucal	Burchell's	*Centropus burchellii*	LC
Courser	Bronze-winged	*Rhinoptilus chalcopterus*	LC
Crake	Black	*Zapornia flavirostra*	LC
Crombec	Long-billed	*Sylvietta rufescens*	LC
Crow	Pied	*Corvus albus*	LC
Cuckoo	Red-chested	*Cuculus solitarius*	LC
Cuckoo	Black	*Cuculus clamosus*	LC

Common Group Name	Common Name	Species	Regional Red List Status
Cuckoo	Jacobin	*Clamator jacobinus*	LC
Cuckoo	African Emerald	*Chrysococcyx cupreus*	LC
Cuckoo	Klaas's	*Chrysococcyx klaas*	LC
Cuckoo	Diederik	*Chrysococcyx caprius*	LC
Cuckooshrike	Black	*Campephaga flava*	LC
Cuckooshrike	Grey	*Ceblepyris caesius*	LC
Curlew	Eurasian	*Numenius arquata*	NT
Darter	African	*Anhinga rufa*	LC
Dove	Red-eyed	*Streptopelia semitorquata*	LC
Dove	Cape Turtle	*Streptopelia capicola*	LC
Dove	Laughing	*Spilopelia senegalensis*	LC
Dove	Namaqua	*Oena capensis*	LC
Dove	Tambourine	*Turtur tympanistria*	LC
Dove	Emerald-spotted Wood	*Turtur chalcospilos*	LC
Dove	Lemon	*Columba larvata*	LC
Dove	Rock	*Columba livia*	LC
Drongo	Fork-tailed	*Dicrurus adsimilis*	LC
Drongo	Common Square-tailed	*Dicrurus ludwigii*	LC
Duck	Yellow-billed	*Anas undulata*	LC
Duck	White-faced Whistling	*Dendrocygna viduata*	LC
Duck	Fulvous Whistling	*Dendrocygna bicolor*	LC
Duck	White-backed	*Thalassornis leuconotus*	LC
Eagle	Southern Banded Snake	*Circaetus fasciolatus*	CR
Eagle	Crowned	*Stephanoaetus coronatus*	VU
Eagle	Long-crested	*Lophaetus occipitalis*	LC
Eagle	Black-chested Snake	*Circaetus pectoralis*	LC
Eagle	African Fish	*Haliaeetus vocifer*	LC
Eagle-Owl	Spotted	*Bubo africanus*	LC
Egret	Great	*Ardea alba*	LC
Egret	Little	*Egretta garzetta*	LC
Egret	Intermediate	*Ardea intermedia*	LC
Egret	Western Cattle	*Bubulcus ibis*	LC
Falcon	Lanner	*Falco biarmicus*	VU
Falcon	Peregrine	*Falco peregrinus*	LC
Finfoot	African	*Podica senegalensis*	VU
Firefinch	African	*Lagonosticta rubricata*	LC
Firefinch	Red-billed	*Lagonosticta senegala*	LC
Fiscal	Southern	*Lanius collaris*	LC
Flamingo	Greater	*Phoenicopterus roseus*	NT
Flycatcher	Spotted	*Muscicapa striata*	LC
Flycatcher	African Dusky	*Muscicapa adusta*	LC

Common Group Name	Common Name	Species	Regional Red List Status
Flycatcher	Ashy	*Muscicapa caerulescens*	LC
Flycatcher	Southern Black	*Melaenornis pammelaina*	LC
Flycatcher	Fiscal	*Melaenornis silens*	LC
Flycatcher	Blue-mantled Crested	*Trochocercus cyanomelas*	LC
Flycatcher	African Paradise	*Terpsiphone viridis*	LC
Gannet	Cape	*Morus capensis*	VU
Godwit	Bar-tailed	*Limosa lapponica*	LC
Goose	African Pygmy	*Nettapus auritus*	VU
Goose	Spur-winged	*Plectropterus gambensis*	LC
Goose	Egyptian	*Alopochen aegyptiaca*	LC
Goshawk	African	*Accipiter tachiro*	LC
Grebe	Little	*Tachybaptus ruficollis*	LC
Greenbul	Yellow-bellied	*Chlorocichla flaviventris*	LC
Greenbul	Sombre	*Andropadus importunus*	LC
Greenshank	Common	*Tringa nebularia*	LC
Guineafowl	Helmeted	*Numida meleagris*	LC
Guineafowl	Crested	*Guttera pucherani*	LC
Gull	Kelp	*Larus dominicanus*	LC
Gull	Grey-headed	*Chroicocephalus cirrocephalus*	LC
Gull	Franklin's	*Leucophaeus pipixcan*	LC
Harrier	African Marsh	*Circus ranivorus*	EN
Harrier-Hawk	African	*Polyboroides typus*	LC
Hawk-Eagle	Ayre's	*Hieraaetus ayresii*	LC
Heron	Grey	*Ardea cinerea*	LC
Heron	Black-headed	*Ardea melanocephala*	LC
Heron	Goliath	*Ardea goliath*	LC
Heron	Purple	*Ardea purpurea*	LC
Heron	Squacco	*Ardeola ralloides*	LC
Heron	Striated	*Butorides striata*	LC
Honeybird	Brown-backed	*Prodotiscus regulus*	LC
Honey-buzzard	European	*Pernis apivorus*	LC
Honeyguide	Greater	*Indicator indicator*	LC
Honeyguide	Scaly-throated	*Indicator variegatus*	LC
Honeyguide	Lesser	*Indicator minor*	LC
Hoopoe	African	*Upupa africana*	LC
Hornbill	Trumpeter	*Bycanistes bucinator*	LC
Hornbill	Crowned	*Lophoceros alboterminatus*	LC
Ibis	African Sacred	*Threskiornis aethiopicus*	LC
Ibis	Hadada	*Bostrychia hagedash*	LC
Indigobird	Dusky	*Vidua funerea*	LC
Jacana	African	*Actophilornis africanus*	LC
Kingfisher	Mangrove	*Halcyon senegaloides*	EN
Kingfisher	Half-collared	*Alcedo semitorquata*	NT

Common Group Name	Common Name	Species	Regional Red List Status
Kingfisher	Pied	*Ceryle rudis*	LC
Kingfisher	Giant	*Megaceryle maxima*	LC
Kingfisher	Malachite	*Corythornis cristatus*	LC
Kingfisher	African Pygmy	*Ispidina picta*	LC
Kingfisher	Brown-hooded	*Halcyon albiventris*	LC
Kingfisher	Striped	*Halcyon chelicuti*	LC
Kite	Yellow-billed	*Milvus aegyptius*	LC
Kite	Black-winged	*Elanus caeruleus*	LC
Lapwing	Crowned	*Vanellus coronatus*	LC
Lapwing	Blacksmith	*Vanellus armatus*	LC
Lark	Rufous-naped	*Mirafra africana*	LC
Lark	Sabota	*Calendulauda sabota*	LC
Longclaw	Yellow-throated	*Macronyx croceus*	LC
Malkoha	Green	*Ceuthmochares australis*	LC
Mannikin	Bronze	*Spermestes cucullata*	LC
Mannikin	Red-backed	*Spermestes nigriceps*	LC
Martin	Rock	*Ptyonoprogne fuligula*	LC
Martin	Sand	*Riparia riparia*	LC
Martin	Brown-throated	*Riparia paludicola*	LC
Masked-weaver	Lesser	*Ploceus intermedius*	LC
Moorhen	Common	*Gallinula chloropus*	LC
Mousebird	Speckled	*Colius striatus*	LC
Mousebird	Red-faced	*Urocolius indicus*	LC
Myna	Common	*Acridotheres tristis*	LC
Nicator	Eastern	*Nicator gularis*	LC
Nightjar	European	*Caprimulgus europaeus*	LC
Nightjar	Fiery-necked	*Caprimulgus pectoralis*	LC
Nightjar	Square-tailed	*Caprimulgus fossii*	LC
Oriole	Black-headed	*Oriolus larvatus*	LC
Osprey	Western	*Pandion haliaetus*	LC
Owl	Western Barn	*Tyto alba*	LC
Painted-snipe	Greater	*Rostratula benghalensis*	LC
Pelican	Great White	*Pelecanus onocrotalus*	VU
Pigeon	Speckled	*Columba guinea*	LC
Pigeon	African Green	*Treron calvus*	LC
Pipit	African	*Anthus cinnamomeus*	LC
Pipit	Striped	*Anthus lineiventris*	LC
Plover	Common Ringed	*Charadrius hiaticula*	LC
Plover	White-fronted	*Charadrius marginatus*	LC
Plover	Kittlitz's	*Charadrius pecuarius*	LC
Plover	Three-banded	*Charadrius tricollaris*	LC
Plover	Grey	*Pluvialis squatarola*	LC
Pratincole	Collared	*Glareola pratincola*	LC

Common Group Name	Common Name	Species	Regional Red List Status
Prinia	Tawny-flanked	*Prinia subflava*	LC
Puffback	Black-backed	*Dryoscopus cubla*	LC
Quelea	Red-billed	*Quelea quelea*	LC
Quelea	Red-headed	*Quelea erythrops*	LC
Robin-Chat	Chorister Robin-Chat	*Cossypha dichroa*	LC
Robin-Chat	Red-capped	*Cossypha natalensis*	LC
Robin-Chat	Cape	*Cossypha caffra*	LC
Roller	European	*Coracias garrulus*	NT
Roller	Lilac-breasted	*Coracias caudatus*	LC
Roller	Broad-billed	*Eurystomus glaucurus*	LC
Sandpiper	Curlew	*Calidris ferruginea*	LC
Sandpiper	Common	*Actitis hypoleucos*	LC
Sandpiper	Marsh	*Tringa stagnatilis*	LC
Sandpiper	Wood	*Tringa glareola*	LC
Saw-wing	Black (Southern Africa)	*Psalidoprocne pristoptera holomelas*	LC
Scrub Robin	Brown Scrub	*Cercotrichas signata*	LC
Scrub Robin	White-browed	*Cercotrichas leucophrys*	LC
Shrike	Red-backed	*Lanius collurio*	LC
Skua	Brown	*Stercorarius antarcticus*	LC
Sparrow	House	*Passer domesticus*	LC
Sparrow	Yellow-throated Bush	*Gymnoris superciliaris*	LC
Sparrow	Southern Grey-headed	*Passer diffusus*	LC
Sparrowhawk	Little	*Accipiter minullus*	LC
Sparrowhawk	Black	*Accipiter melanoleucus*	LC
Spoonbill	African	*Platalea alba*	LC
Spurfowl	Swainson's	*Pternistis swainsonii*	LC
Starling	Common	*Sturnus vulgaris*	LC
Starling	Wattled	*Creatophora cinerea*	LC
Starling	Violet-backed	*Cinnyricinclus leucogaster*	LC
Starling	Cape	*Lamprotornis nitens*	LC
Starling	Black-bellied	*Notopholia corusca*	LC
Starling	Red-winged	*Onychognathus morio*	LC
Stilt	Black-winged	*Himantopus himantopus*	LC
Stint	Little	*Calidris minuta*	LC
Stonechat	African	*Saxicola torquatus*	LC
Stork	Saddle-billed	*Ephippiorhynchus senegalensis*	EN
Stork	Woolly-necked	*Ciconia episcopus*	LC
Sunbird	Purple-banded	*Cinnyris bifasciatus*	LC
Sunbird	White-bellied	*Cinnyris talatala*	LC
Sunbird	Grey	*Cyanomitra veroxii*	LC
Sunbird	Olive	*Cyanomitra olivacea*	LC
Sunbird	Collared	*Hedydipna collaris*	LC

Common Group Name	Common Name	Species	Regional Red List Status
Sunbird	Amethyst	*Chalcomitra amethystina*	LC
Sunbird	Scarlet-chested	*Chalcomitra senegalensis*	LC
Swallow	Barn	*Hirundo rustica*	LC
Swallow	White-throated	*Hirundo albigularis*	LC
Swallow	Wire-tailed	*Hirundo smithii*	LC
Swallow	Red-breasted	*Cecropis semirufa*	LC
Swallow	Greater Striped	*Cecropis cucullata*	LC
Swallow	Lesser Striped	*Cecropis abyssinica*	LC
Swamphen	African	*Porphyrio madagascariensis*	LC
Swift	African Black	*Apus barbatus*	LC
Swift	White-rumped	*Apus caffer*	LC
Swift	Little	*Apus affinis*	LC
Swift	African Palm	*Cypsiurus parvus*	LC
Tchagra	Black-crowned	*Tchagra senegalus*	LC
Teal	Red-billed	*Anas erythrorhyncha*	LC
Teal	Blue-billed	*Spatula hottentota*	LC
Tern	Caspian	*Hydroprogne caspia*	VU
Tern	Common	*Sterna hirundo*	LC
Tern	Sandwich	*Thalasseus sandvicensis*	LC
Tern	Lesser Crested	*Thalasseus bengalensis*	LC
Tern	Greater Crested	*Thalasseus bergii*	LC
Tern	Little	*Sternula albifrons*	LC
Tern	White-winged	*Chlidonias leucopterus*	LC
Tern	Whiskered	*Chlidonias hybrida*	LC
Thick-knee	Water	*Burhinus vermiculatus*	LC
Thrush	Kurrichane	*Turdus libonyana*	LC
Thrush	Groundscraper	*Turdus litsitsirupa*	LC
Tinkerbird	Red-fronted	*Pogoniulus pusillus*	LC
Tinkerbird	Yellow-rumped	*Pogoniulus bilineatus*	LC
Tit	Southern Black	*Melaniparus niger*	LC
Tit-Flycatcher	Grey	*Myioparus plumbeus*	LC
Trogon	Narina	*Apaloderma narina*	LC
Turaco	Purple-crested	*Gallirex porphyreolophus*	LC
Turaco	Livingstone's	*Tauraco livingstonii*	LC
Turnstone	Ruddy	*Arenaria interpres*	LC
Twinspot	Green	*Mandingoa nitidula*	LC
Vulture	Palm-nut	*Gypohierax angolensis*	LC
Wagtail	African Pied	*Motacilla aguimp*	LC
Wagtail	Cape	*Motacilla capensis*	LC
Wagtail	Mountain	*Motacilla clara*	LC
Wagtail	Western Yellow	*Motacilla flava*	LC
Warbler	Willow	*Phylloscopus trochilus*	LC
Warbler	Great Reed	*Acrocephalus arundinaceus*	LC

Common Group Name	Common Name	Species	Regional Red List Status
Warbler	Lesser Swamp	*Acrocephalus gracilirostris*	LC
Warbler	African Reed	*Acrocephalus baeticatus*	LC
Warbler	Marsh	*Acrocephalus palustris*	LC
Warbler	Little Rush	*Bradypterus baboecala*	LC
Warbler	African Yellow	*Iduna natalensis*	LC
Wattle-eye	Black-throated	*Platysteira peltata*	LC
Waxbill	Orange-breasted	*Amandava subflava*	LC
Waxbill	Grey	*Glaucestrilda perreini*	LC
Waxbill	Common	*Estrilda astrild*	LC
Weaver	Dark-backed	*Ploceus bicolor*	LC
Weaver	Spectacled	*Ploceus ocularis*	LC
Weaver	Village	*Ploceus cucullatus*	LC
Weaver	Cape	*Ploceus capensis*	LC
Weaver	Yellow	*Ploceus subaureus*	LC
Weaver	Southern Brown-throated	*Ploceus xanthopterus*	LC
Weaver	Southern Masked	*Ploceus velatus*	LC
Weaver	Thick-billed	*Amblyospiza albifrons*	LC
Whimbrel	Eurasian	*Numenius phaeopus*	LC
White-eye	Cape	*Zosterops virens*	LC
Whydah	Pin-tailed	*Vidua macroura*	LC
Widowbird	Red-collared	*Euplectes ardens*	LC
Widowbird	Fan-tailed	*Euplectes axillaris*	LC
Wood Hoopoe	Green	*Phoeniculus purpureus*	LC
Woodpecker	Golden-tailed	*Campethera abingoni*	LC
Woodpecker	Cardinal	*Dendropicos fuscescens*	LC
Woodpecker	Olive	*Dendropicos griseocephalus*	LC
	Hamerkop	*Scopus umbretta*	LC
	Sanderling	*Calidris alba*	LC
	Ruff	*Calidris pugnax*	LC
	Neddicky	*Cisticola fulvicapilla*	LC
	Mallard	*Anas platyrhynchos*	LC

APPENDIX 3: IMPACT ASSESSMENT METHOD

Status of Impact

The impacts are assessed as either having a:

- Negative effect (i.e., at a `cost' to the environment),
- Positive effect (i.e., a `benefit' to the environment), or
- Neutral effect on the environment.

Extent of the Impact

(1) Site (site only),

(2) Local (site boundary and immediate surrounds),

(3) Regional (within the City of Johannesburg),

(4) National, or

(5) International.

Duration of the Impact

The length that the impact will last for is described as either:

(1) immediate (<1 year)

(2) short term (1-5 years),

(3) medium term (5-15 years),

(4) long term (ceases after the operational life span of the project),

(5) Permanent.

Magnitude of the Impact

The intensity or severity of the impacts is indicated as either:

(0) none,

(2) Minor,

(4) Low,

(6) Moderate (environmental functions altered but continue),

(8) High (environmental functions temporarily cease), or

(10) Very high / Unsure (environmental functions permanently cease).

Probability of Occurrence

The likelihood of the impact actually occurring is indicated as either:

(0) None (the impact will not occur),

(1) improbable (probability very low due to design or experience)

(2) low probability (unlikely to occur),

(3) medium probability (distinct probability that the impact will occur),

(4) high probability (most likely to occur), or

(5) Definite.

Significance of the Impact

Based on the information contained in the points above, the potential impacts are assigned a significance rating (S). This rating is formulated by adding the sum of the numbers assigned to extent (E), duration (D) and magnitude (M) and multiplying this sum by the probability (P) of the impact.

S=(E+D+M)P

The significance ratings are given below

- **(<30) Low** (i.e., where this impact would not have a direct influence on the decision to develop in the area),
- **(30-60) Medium** (i.e., where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- **(>60) High** (i.e., where the impact must have an influence on the decision process to develop in the area).

Each impact was considered from the perspective of whether losses or gains would be irreversible or result in the irreplaceable loss of biodiversity of ecosystem services. The level of confidence was also determined and rated as low, medium or high (Table 7).

Table 7: Definition of reversibility, irreplaceability and confidence ratings.

Rating	Reversibility	Irreplaceability	Confidence
Low	Permanent modification, no recovery possible.	No irreparable damage and the resource isn't scarce.	Judgement based on intuition.
Medium	Recovery possible with significant intervention.	Irreparable damage but is represented elsewhere.	Based on common sense and general knowledge
High	Recovery likely.	Irreparable damage and is not represented elsewhere.	Substantial data supports the assessment